REMARKS

Claims 38-46 and 48-63 were examined. Claims 38, 59, and 61-63 have been amended. Claim 60 has been canceled. Re-examination and reconsideration of pending claims 38-46, 48-59, and 61-63 are respectfully requested.

Rejection of Claims under 35 U.S.C. § 103(a)

Claims 38-46, 48-59, and 61-63 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over the Doctoral Dissertation by Vijayen S. Veerasamy. Claim 38 was also rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over U.S. Patent No. 6,194,047 B1, issued to Hayashi. Such rejections are traversed in part and overcome in part as follows.

To more clearly claim the present invention, Applicants have amended claim 38 to recite an article comprising a substrate and a layer disposed over the substrate. The layer comprises a highly tetrahedral amorphous carbon having more than about 15% sp^3 carbon-carbon bonds and a single peak Raman spectrum, the layer further comprising at least one of hydrogen and nitrogen. In particular, claim 38 now recites that a percentage of sp^3 carbon-carbon bonds in the layer increases as a layer thickness decreases. Support for this amendment can be found throughout the originally filed application, and particularly on page 31, line 15 through page 33, line 26; page 32, Table II. Such a material property is not shown or reasonably suggested in the cited art.

As the Examiner certainly knows and appreciates, *prima facie* obviousness requires that three basic criteria be met. First, the Examiner must show that the prior art references, alone or in combination, teach or suggest all of the limitations of the claims. M.P.E.P. § 2143.03; *In re Royka*, 180 U.S.P.Q. 580 (CCPA 1974). Second, there must some suggestion or motivation, either in the references or in the knowledge generally available to one of ordinary skill in the art, for the proposed modifications to the teachings of the references so as to produce the claimed invention. M.P.E.P. § 2143.01; *In re Fine*, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988). Finally, it must be shown that one of ordinary skill in the art would have had a reasonable expectation of success in practicing or carrying out the claimed invention based on the cited references. M.P.E.P. § 2142; *In*

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re Vaeck, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991). The obviousness rejections stated by the Examiner fails on all three criteria.

The Veerasamy dissertation does describe the use of compact filtered cathodic vacuum arc deposition systems for the growth of tetrahedral amorphous carbon films for semiconductor applications. Veerasamy Dissertation, page 1. However, this reference fails to describe or suggest a highly tetrahedral amorphous carbon layer having a percentage of sp^3 carbon-carbon bonds which increases with a decreasing layer thickness. In fact, a close examination of this reference reveals that sp^2 carbon-carbon bonding, i.e. graphite, increases with decreasing layer thickness. Veerasamy Dissertation, pages 115-117, Section 4.3.3 Thickness Dependence of SP^2-Bonded Fraction. Specifically, Veerasamy investigates the relationship between sp^2 bonding as a function of thickness of the tetrahedral amorphous carbon and concludes that,

> there is a also a noticeable increase in the relative intensity of the $1s \rightarrow \pi^*$ peak with decreasing ta-C film thickness from 200 nm [2000 Å] down to 10 nm [100 Å]. This indicates an enhancement in sp^2 contribution in the thinner films .... This imply that the sp^2 fraction within the bulk of the thinnest film is highest.

Id. Hence, Veerasamy effectively teaches away from Applicants invention of a tetrahedral amorphous carbon layer having sp^3 carbon-carbon bonding which increases with decreasing layer thickness, as the Veerasamy Dissertation acknowledges that its thinnest layers promote the highest formation of sp^2 bonding. With respect to the Hayashi reference, Applicants fail to see even a remote teaching or suggestion for a highly tetrahedral amorphous carbon layer having more than about 15% sp^3 carbon-carbon bonds, much less a layer whose sp^3 carbon-carbon bonding increases with decreasing thickness layer. Applicants request, if the present rejection is maintained, that the Examiner show or explain where the cited references, or how knowledge of those skilled in the art, teach or suggest the proposed limitation.

In contrast, work in connection with the present invention has shown that when films are deposited on a substrate utilizing plasma beam sources and acetylene plasmas (as shown in Fig. 3A), a percentage of sp^3 carbon-carbon content in the bulk of

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the films increases with decreasing thickness. Application, page 33, lines 5-7. Specifically, it was observed from the Raman spectra of films having a thickness in the range from 40 Å to 200 Å that the Id/Ig (the area ratio of the D and G peaks) ratio increased with increasing film thickness. Application, Table II. This indicates that the thinnest films had the highest content of sp^3 carbon-carbon bonds with very low levels of graphitic phase clustering, unlike the layers described in the Veerasamy Dissertation which promote sp^2 carbon-carbon bonding with decreasing layer thickness.

Absent any cited suggestion or reasonable motivation in the cited art for a highly tetrahedral amorphous carbon layer having a percentage of sp^3 carbon-carbon bonds which increases with decreasing layer thickness, *prima facie* obviousness has not been established, and as such, claim 38 (and the dependent claims 39-46 and 48-59) are allowable.

Dependent claims 53 and 54 are further allowable as these claims recite that the highly tetrahedral amorphous carbon layer has a thickness of less than about 75 Å and 50 Å, respectively. The Veerasamy Dissertation and the Hayashi references do not teach or suggest such thin films. The Examiner asserts that the it would have been obvious to one of ordinary skill in the art to minimize thickness for electronic applications to enable micro miniaturization of electronic devices. Office Action dated August 22, 2001, page 3. Applicants ask that the Examiner show or explain where the cited art references (or knowledge generally available to one of ordinary skill in the art) teach or suggest film thickness less than about 75 Å and 50 Å. See In re Zurko, 59 U.S.P.Q.2d 1693 (Fed Cir. 2001) ([I]n a determination of patentability .... the Board cannot simply reach conclusion based on its own understanding or experience - or on its assessment of what would be basic knowledge or common sense. Rather, the Board must point to some concrete evidence in the record in support of these findings.)

Amended independent claim 59 recites an article comprising a substrate and a layer disposed over the substrate, the layer comprising a highly tetrahedral amorphous carbon having more than about 15% sp^3 carbon-carbon bonds and a single peak Raman spectrum. In particular, the sp^3 carbon-carbon bonds are at least in part formed by directing an energized stream of carbon ions having a uniform weight and a

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substantially uniform impact energy toward the substrate. Such uniformity characteristics have not been shown or suggested in the cited references. The present invention advantageously allows for deposition of carbon ions having a uniform weight with uniform energy by ionizing a source material to form a plasma and confining the plasma within a plasma volume, wherein the plasma is capacitively coupled to form a stream of uniform ions flowing outwardly from within the plasma volume and onto the substrate. Application, page 5, lines 34-38; page 8, lines 25-38. Since an energized stream of carbon ions having a uniform weight and a substantially uniform impact energy of claim 59 has not been shown or suggested, claim 59 is allowable.

Independent claims 62 and 63 are directed to an article comprising a substrate and a layer disposed over the substrate, wherein the layer comprises a highly tetrahedral amorphous carbon having a percentage of sp^3 carbon-carbon bonds which increases with decreasing layer thickness. Hence, these claims should be allowable for many of the reasons given above regarding claim 1.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 650-326-2400.

Respectfully submitted,

Nena Bains
Reg. No. 47,400

TOWNSEND and TOWNSEND and CREW LLP
Two Embarcadero Center, 8th Floor
San Francisco, California 94111-3834
Tel: (415) 576-0200
Fax: (415) 576-0300
NB:kab PA 3214310 v1

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

38. (Twice Amended) An article comprising:

a substrate; and

a layer disposed over the substrate, the layer comprising a highly tetrahedral amorphous carbon having more than about 15% sp^3 carbon-carbon bonds and a single peak Raman spectrum, the layer further comprising at least one of hydrogen and nitrogen;

wherein a percentage of sp^3 carbon-carbon bonds in the layer increases as a layer thickness decreases.

59. (Amended) An article comprising:

a substrate; and

a layer disposed over the substrate, the layer comprising a highly tetrahedral amorphous carbon having more than about 15% sp^3 carbon-carbon bonds and a single peak Raman spectrum, the layer further comprising at least one of hydrogen and nitrogen **[An article as in claim 38]**, wherein the sp^3 carbon-carbon bonds are at least in part formed by directing an energized stream of carbon ions having a uniform weight and a substantially uniform impact energy toward the substrate.

Please cancel claim 60.

61. (Amended) An article as in claim 59 **[38]**, wherein the sp^3 carbon-carbon bonds are at least in part formed by directing an energized stream of carbon ions toward the substrate with an ion impact energy between about 100 and 120 eV for each carbon atom.

62. (Amended) An article comprising:

a substrate; and

a layer disposed over the substrate, the layer comprising a highly tetrahedral amorphous carbon having more than about 15% sp^3 carbon-carbon bonds and a carbon bonding pattern characterized by a single peak Raman spectrum;

wherein a percentage of sp^3 carbon-carbon bonds in the layer increases as a layer thickness decreases.

63. (Amended) An article comprising:

a substrate; and

a layer disposed over the substrate, the layer comprising a highly tetrahedral amorphous carbon having more than about 15% sp^3 carbon-carbon bonds and a carbon bonding pattern being free from a D-peak Raman spectrum;

wherein a percentage of sp^3 carbon-carbon bonds in the layer increases as a layer thickness decreases.

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